



Five-Year Review Report
Fourth Five-Year Review Report
for
Gratiot County Landfill
St. Louis
Gratiot County, Michigan

September 2006

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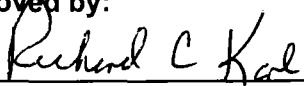
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9-28-06

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Table 1	Site Chronology
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Attachments

Attachment 1	Community Notification of Five-Year Review
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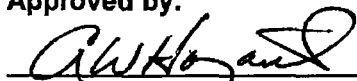
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List of Acronyms

AISL	Acute Inhalation Screening Level
BPW	Board of Public Works
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeter/second
GCC	Groundwater Contact Criteria
GCL	Gratiot County Landfill
GETS	Groundwater Extraction and Treatment System
GSI	Groundwater/Surface Water Interface
GVIAI	Groundwater Volatilization to Indoor Air Inhalation
HELP	Hydrologic Evaluation of Landfill Performance
IC	Institutional Control
LEL	Lower Explosive Limit
MACTEC	MACTEC Engineering and Consulting of Michigan, Inc.
MDEQ	Michigan Department of Environmental Quality
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
Part 201	Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
PBB	Polybrominated biphenyl
PCB	Polychlorinated biphenyl
PVC	Polyvinyl Chloride
RDWC	Residential Drinking Water Criteria
RI/FS	Remedial Investigation and Feasibility Study
SARA	Superfund Amendments and Reauthorization Act
SVOC	Semi-Volatile Organic Compound
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

Executive Summary

This Five-Year Review Report has been prepared for the Gratiot County Landfill (GCL) Superfund Site in St. Louis, Gratiot County, Michigan. The purpose is to determine *whether the remedy at this site is protective of human health and the environment.*

The GCL is a 40-acre landfill located on an 80-acre parcel of land, owned by the Gratiot County Board of Public Works (BPW), in the southeast quarter of Section 30, Township 12 North, Range 2 West, Bethany Township, Gratiot County, Michigan (Figure 1). The landfill began operation in 1971 by the Gratiot County BPW for the disposal of domestic, commercial, and industrial solid waste. In 1973, the compound polybrominated biphenyl (PBB) became widely known when it was determined that livestock feed had been accidentally mixed with BP-6 (PBB), a flame retardant with the trade name Firemaster. Due to the information about PBB disposal at the GCL, and because stockpiles of the contaminated feed were discovered by the Michigan Department of Environmental Quality (MDEQ) on the surface of and around the GCL, a remedial investigation and feasibility study (RI/FS) was completed by the MDEQ in 1980. The RI found PBB as well as elevated levels of other contaminants in shallow groundwater on and near the site. PBB was not detected in residential wells, surface drainage, or nearby streams. The stockpiled feed was disposed into the GCL.

Under a 1982 Consent Judgment with the MDEQ and the United States Environmental Protection Agency (USEPA), the responsible party, Velsicol, was ordered to pay cost recovery and to fund certain remedial actions at the GCL site. In 1984, the work was initiated by the MDEQ and included test borings; constructing a slurry wall around the perimeter of the landfill (Figure 2); constructing burial cells inside the landfill to encapsulate the PBB-contaminated waste; excavation and disposal of approximately 20,000 cubic yards of PBB-laden waste from property located across the road; installing a perimeter fence around the landfill; capping the landfill with a compacted clay layer to reduce infiltration; and constructing a lagoon to collect surface water runoff. Due to the settlement with Velsicol, ongoing and future operation, maintenance, and remedial action costs at the landfill are being funded by the State of Michigan.

The remedy at the GCL is complete and is protective of human health and the environment at this time, and exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to remain protective in the long-term the landfill cap must be maintained and effective institutional controls (IC) must be implemented, maintained, and monitored.

Site remedies are effective and all pathways that may affect potential receptors are incomplete at the time of this five-year review. Site fencing limits access to the site and allows only authorized visitors. The slurry wall constructed around the perimeter of the GCL has gaps on the southwest side and partially on the northern side; but the concentrations in the groundwater still appear to be protective. Groundwater data indicates that groundwater quality outside of the slurry wall has remained stable and there is no migration off the GCL property. A clay cover system has been installed over the waste materials and periodic repairs have been completed. Methane gas vents and solar-powered flares are relieving gas pressure in the landfill and methane monitoring of off-site monitoring probes show that methane gas is not migrating from the landfill to any appreciable extent. Continued groundwater and methane monitoring are also necessary to ensure that the remedy remains protective of human health and the environment.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name (from wasteLAN): Gratiot County Landfill

EPA ID (from WasteLAN): MID980506281

Region: V **State:** MI **City/County:** City of St. Louis, Gratiot County, Bethany Township

SITE STATUS

NPL status: ☒ Final ☐ Deleted ☐ Other (specify) _____

Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☒ Complete

Multiple OUs?* ☐ YES ☒ NO **Construction completion date:** 07 / 19 / 1995

Has site been put into reuse? ☐ YES ☒ NO

REVIEW STATUS

Lead agency: ☐ EPA ☒ State ☐ Tribe ☐ Other Federal Agency _____

Author name: Matt Williams

Author title: Environmental Quality Analyst **Author affiliation:** MDEQ

Review period:** 03 / 24 / 2006 to 09 / 30 / 2006

Date(s) of site inspection: 6 / 15 / 2006

Type of review:

- ☐ Post-SARA ☒ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: ☐ 1 (first) ☐ 2 (second) ☐ 3 (third) ☒ Other (specify) 4 (Fourth)

Triggering action:

- ☐ Actual RA Onsite Construction at OU # _____ ☐ Actual RA Start at OU# _____
☐ Construction Completion ☒ Previous Five-Year Review Report
☐ Other (specify) _____

Triggering action date (from WasteLAN): 09 / 28 / 2001

Due date (five years after triggering action date): 9 / 28 / 2006

* ["OU" refers to operable unit.]

** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

1. Hydrologic Evaluation of Landfill Performance model indicates that 9.64 million gallons of precipitation percolates through the cover system each year.
2. Slurry wall is discontinuous at the southwest portion of the GCL, and to a lesser extent along the northern side.
3. Grades on the landfill are at less than four percent, and settlement of the cover system continues, which can reduce runoff and increase leachate production.
4. The remedy does not provide for unrestricted land use and ICs are required to maintain the cover system, and restrict groundwater use on the GCL.

Recommendations and Follow-up Actions:

1. Continue site-wide annual groundwater monitoring and reporting. This action would affect future protectiveness of the remedy, and determine if the slurry wall is functioning sufficiently to protect the public and the environment.
2. Continue quarterly methane monitoring at on-site and off-site monitoring locations. This will include the future monitoring of methane concentrations in the groundwater. This action would affect future protectiveness of the remedy, and determine if the slurry wall is functioning sufficiently to protect the public and the environment.
3. Monitor and maintain the cover system. It is necessary to maintain the cover system, mow grass, repair erosion areas, repair settlement areas, maintain methane vent and solar flares, and add new vents and flares as required, and other operation and maintenance (O&M) activities. This action would affect future protectiveness of the remedy.
4. Reactivate the groundwater extraction and treatment system (GETS), including any necessary sampling, if groundwater data indicates an unacceptable increase in groundwater concentrations outside the southwest corner of the landfill. This action would affect future protectiveness of the remedy.
5. Develop a plan to implement the ICs necessary to ensure the protectiveness of the remedy. The State will submit the plan to the USEPA in six months (March 2007). The plan itself will include a schedule for accomplishing the necessary steps to implement the ICs.

Protectiveness Statement(s):

The remedy at the GCL is complete and is protective of human health and the environment at this time, and exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to remain protective in the long-term the landfill cap must be maintained and effective ICs must be implemented, maintained, and monitored.

Site remedies are effective and all pathways that may affect potential receptors are incomplete at the time of this five-year review. Site fencing limits access to the site and allows only authorized visitors. The slurry wall constructed around the perimeter of the GCL has gaps on the southwest side and partially on the northern side; but the concentrations in the groundwater still appear to be protective. Groundwater data indicates that groundwater quality outside of the slurry wall has remained stable and there is no migration off the GCL property. A clay cover system has been installed over the waste materials and periodic repairs have been completed. Methane gas vents and solar-powered flares are relieving gas pressure in the landfill and methane monitoring of off-site monitoring probes show that methane gas is not migrating from the landfill to any appreciable extent. Continued groundwater and methane monitoring are also necessary to ensure that the remedy remains protective of human health and the environment.

The next five-year review for the Gratiot County Landfill site will be completed by the MDEQ prior to September 30, 2011, the 25th year after the initial remedy action.

I. Introduction

The Purpose of the Review

The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review Reports. In addition, Five-Year Review Reports identify issues found during the review, if any, and recommendations to address them.

Authority for Conducting the Five-Year Review

The Agency is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA §121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The Agency interpreted this requirement further in the NCP; 40 CFR §30.430(f)(4)(ii) which states:

If a remedial action is selected that results in hazardous substance, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

Who Conducted the Five-Year Review

The Michigan Department of Environmental Quality (MDEQ) has conducted a five-year review of the remedial actions implemented at the Gratiot County Landfill (GCL) Superfund site in St. Louis, Gratiot County, Michigan. This review was conducted from March 2006 through June 2006. This report documents the results of the review. MACTEC Engineering and Consulting of Michigan, Inc. (MACTEC) assisted in the preparation of the review. MACTEC is a consultant retained by the MDEQ to assist in remedial activities at the GCL.

Other Review Characteristics

This is the fourth five-year review for the GCL site, which is conducted as a matter of policy, to evaluate whether a completed remedial action remains protective of human health and the environment at sites where hazardous waste remains on-site at levels that do not allow for unlimited use and unrestricted exposure. Prior five-year reviews were conducted by the MDEQ in 1991, 1996, and 2001. Those Five-Year Review Reports were submitted to and approved by the United States Environmental Protection Agency (USEPA). The triggering action for this fourth five-year review is the issuance date of the previous five-year review on September 28, 2001.

II. Site Chronology

Table 1 (at the end of the report) provides a chronology of important site events and relevant dates which are illustrative but not comprehensive of the events completed.

III. Background

Physical Characteristics

The GCL is a 40-acre landfill located on an 80-acre parcel of land, owned by the Gratiot County Board of Public Works (BPW), in the southeast quarter of Section 30, Township 12 North, Range 2 West, Bethany Township, Gratiot County, Michigan (Figure 1). The GCL is bounded on the south by Jackson Road, to the west and north by undeveloped land, and to the east by a drainage ditch that discharges to a county drain. Topography ranges from elevation 750 (Mean Sea Level) on the southwest corner, to 735 on the north. The GCL measures approximately 1,400 feet in length along each side, and rises approximately 10 to 20 feet above surrounding elevations except near the center of the southern boundary where the GCL edge is near natural ground level. The GCL has a high point in the southwestern portion of the cover system and an approximately 2.0-acre, square-shaped stormwater storage lagoon in the northwestern portion of the cover system. Approximately 24 acres of the GCL cover system drain to the stormwater storage lagoon under the existing conditions topography. Runoff from the remainder of the GCL occurs along all edges.

The GCL is underlain by glacial deposits comprising three hydrogeologic units. The upper 10 to 15 feet of soil consists primarily of silts and clays with interbedded sands and silty sands. A 5- to 15-foot thick, silty sand is encountered below the interbedded zone over most of the area. A soft to firm silty clay is encountered below the silty sand zone that is up to 20 feet thick. At the majority of the locations where the silty clay is present, perched groundwater is encountered in the overlying silty sand.

A sand and gravel aquifer is present below the silty clay. The sand and gravel aquifer is fairly uniform in thickness east to west, but thins to the north and south, suggesting a buried channel deposit. Along the axis of the channel, the sand and gravel ranges in thickness from 15 to 30 feet. The downgradient extent of the channel is unknown. Outside the channel, the sand and gravel averages 10- to 20- feet thick. Where the overlying silty clay is present, the aquifer is confined.

A stiff to hard clay till is encountered below the sand and gravel deposit. This clay is believed to be continuous across the site and is considered to be a low-permeability layer, or aquitard. Groundwater in the area of the channel deposits generally flows in a southwesterly direction.

Land Use and Resources

The area surrounding the GCL is primarily agricultural with some residential development along Jackson Road. A small park is located southwest of the GCL. Four surface bodies of water are located in the immediate proximity of the GCL. They are: the Pine River (approximately one mile northwest of the GCL); Emma Burnham pond (approximately 1,300 feet south of the southeast corner of the GCL) which is used for nature observation and possibly pond fishing; and two small ponds (1,300 feet east of the GCL, and 600 feet west of the GCL).

History of Contamination

The landfill was operated in 1971 by the Gratiot County BPW for the disposal of domestic, commercial, and industrial solid waste. The MDEQ licensed the GCL for operation in 1974. Because of violation of conditions of operation stipulated in the MDEQ permit, in 1976 the MDEQ initiated proceedings to revoke the GCL license. In late 1976, the USEPA notified the MDEQ that 269,000 pounds of polybrominated biphenyl (PBB) contaminated waste had been disposed of at the GCL from 1971 to 1974 by the Michigan Chemical Company (Velsicol).

In 1973, the compound PBB became widely known when it was determined that livestock feed had been accidentally mixed with BP-6 (PBB), a flame retardant with the trade name Firemaster. The Firemaster material was manufactured by Velsicol at its St. Louis, Michigan facility. Velsicol also manufactured the product Nutrimaster, a magnesium oxide-based livestock feed additive. Due to mixing of the two products, Michigan livestock in the millions consumed PBB-laden feed, eventually necessitating their destruction. Additionally, to reduce additional exposure, tons of dairy products such as eggs, milk, butter, and cheese, were also destroyed. This incident is considered one of the most costly and disastrous contamination incidents to have occurred in United States agricultural history and is estimated to have exposed 90 percent of Michigan residents to some level of PBB contamination.

Initial Response

Due to the information about PBB disposal at the GCL, and because stockpiles of the contaminated feed were discovered by the MDEQ on the surface of and around the GCL, the MDEQ began site investigations, in March 1977, and determined that PBB and other contaminants from the refuse had entered the groundwater system. A remedial investigation and feasibility study (RI/FS) was completed by the MDEQ in 1980. The RI found PBB as well as elevated levels of other contaminants in shallow groundwater on and near the site. PBB was not detected in residential wells, surface drainage, or nearby streams. The stockpiled feed was disposed into the GCL. PBB is the primary contaminant of concern. Other contaminants that have been consistently identified with concentrations above the detection limits include lead and zinc.

Summary of Basis for Taking Action

In 1973, the compound PBB became widely known when it was determined that livestock feed had been accidentally mixed with BP-6 (PBB), a flame retardant with the trade name *Firemaster*. Due to mixing of the two products, Michigan livestock in the millions consumed PBB-laden feed, eventually necessitating their destruction. Additionally, to reduce additional exposure, tons of dairy products such as eggs, milk, butter, and cheese, were also destroyed. PBB was disposed at the GCL, and stockpiles of the contaminated feed were discovered by the MDEQ on the surface of and around the GCL. Investigations were completed to identify the extent of contamination and implement remedial actions.

IV. Remedial Actions

Under a 1982 Consent Judgment with the MDEQ and the USEPA, the responsible party, Velsicol, was ordered to pay cost recovery and to fund certain remedial actions at the GCL site. The remedial actions, addressing containment of contaminants, were identified in an *Evaluation of Remedial Alternatives for the Gratiot County Landfill at St. Louis Michigan* (Appendix C of *Environmental Impact Assessment for Gratiot County Landfill Remedial Action*, 1982). Relevant remedial actions were:

- Construction of a slurry wall around the entire landfill and keyed into an underlying clay layer
- Installation of an impermeable soil cap with five-foot thickness and a maximum permeability of 10^{-7} centimeters per second (cm/sec)
- Installation of a landfill gas venting system
- Construction and implementation of a groundwater pumping system to lower the groundwater level and remove major areas of contaminated groundwater
- Development and implementation of landfill gas and groundwater monitoring programs to ensure the integrity of remedial action.

The cleanup levels and objectives of the remedial action were to “contain the entire landfill both beneath and on the surface in order to curtail water movement into and from the site, and to prevent more extensive groundwater pollution.”

At the GCL site, Velsicol provided clay for a low permeability cover. The MDEQ hired a contractor to implement the remedial action. In 1984, the work initiated included test borings; constructing a slurry wall around the perimeter of the landfill (Figure 2); constructing burial cells inside the landfill to encapsulate the PBB-contaminated waste; excavation and disposal of approximately 20,000 cubic yards of PBB-laden waste from property located across the road; installing a perimeter fence around the landfill; capping the landfill with a compacted clay layer to reduce infiltration; and constructing a lagoon to collect surface water runoff. Due to the settlement with Velsicol, ongoing and future operation, maintenance, and remedial action costs at the landfill are being funded by the State of Michigan.

In 1992, benzene was detected in monitor wells outside the slurry wall in the southwest corner of the GCL. Based on water elevations inside and outside the slurry wall, the MDEQ suspected breaches in the slurry wall. This prompted the MDEQ to investigate the extent of contamination which may have migrated outside the slurry wall and also any potential impacts to human health and the environment. The MDEQ also conducted

further hydrogeological studies to define a narrow sand and gravel paleo-river channel underlying this area which could provide a groundwater migration pathway away from the GCL.

Because of the elevated levels of volatile organic compounds (VOCs) detected in wells located outside the southwest slurry wall, the MDEQ installed a groundwater extraction and treatment system (GETS). The GETS operated from July 1998 until November 2005 to capture and treat the migrating VOCs in groundwater from the landfill. The installation of GETS was consistent with the prior five-year review recommendations. However, because the GETS utilized air stripping, it captured but did not treat inorganics in the groundwater.

In 2000, the MDEQ issued a contract to Harding ESE, Inc. to conduct an engineering assessment of the GCL. Tasks included an evaluation of the effectiveness of the landfill cap, the adequacy of the landfill gas venting, and the integrity of the slurry wall. The evaluation was able to better define the extent and location of the known slurry wall breach. The engineering assessment also included a risk analysis and evaluation of appropriate remedial alternatives, including cost estimates for adding the capability to capture and treat the inorganic compounds in the groundwater. As an initial part of the study, residential wells around the GCL were sampled to ensure that no ongoing exposure from the landfill was occurring. The information obtained was summarized in various technical memoranda, including the "Cap and Slurry Wall Assessment" and the "Landfill Containment Evaluation."

These reports concluded that significant gaps between the bottom of the slurry wall and the basal clay layer were present along much of the southern wall and the southern half of the west wall. In these areas the basal clay is at a greater depth than other areas of the slurry wall. It was speculated that the trenching equipment used for the slurry wall installation did not have the range to reach down and key into the basal clay in the southwest area of the GCL. Other than those identified breach areas in the southwest corner the slurry wall appeared to be in relatively good condition in most areas with permeabilities generally in the 1×10^{-8} cm/sec range. There was evidence that migration of a lesser extent was also occurring along the northern portion of the slurry wall.

The reports determined that there were areas of the cover where appreciable amounts of sand and silt were present instead of clay with the cover thickness ranging from 2- to at least 15-feet thick. The average permeability of the cover was determined to be 3.3×10^{-6} cm/sec. The field investigations identified areas of the cover system where surface water ponding, dead vegetation, and animal burrows were evident.

A Hydrologic Evaluation of Landfill Performance (HELP) computer model was applied to an analysis of infiltration through the cover. The HELP model estimated that 29.5 percent of the average rainfall percolates through the cap and into the landfill. This was estimated to be approximately 9.64 million gallons. The assessment concluded that the cover system was not functioning as an effective infiltration barrier.

The reports concluded that landfill gas did not appear to be migrating from the GCL to any significant extent. The existing passive gas vents appeared to be in relatively good shape.

During the preparation of the reports the seven residential wells around the GCL were sampled for VOCs, Semi-Volatile Organic Compounds (SVOCs), poly-chlorinated biphenyls (PCBs), pesticides, and inorganics. The results indicated that the residential wells had not been impacted by site contamination.

The sampling events also encountered groundwater outside of the slurry wall which had concentrations of VOCs, SVOCs, and inorganics (chloride, iron, manganese, zinc, and ammonia) above Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, Residential Drinking Water Criteria (RDWC) at the southwest corner of the GCL. Chloride concentrations above the Part 201 aesthetic RDWC criteria were observed at 31 locations inside and outside of the GCL, with the highest concentrations along the southwest corner. Sodium concentrations were also noted above Part 201 RDWC criteria in wells on the northern side of the GCL. Ammonia was present at most sample locations and was attributed to agricultural practices in the area but was an order of magnitude greater along the southwest side of the GCL.

There were exceedances above Part 201 RDWC criteria for arsenic, cadmium, lead, and zinc at the southwest corner of the GCL during the December 2000 sampling event. Lead concentrations exceeded Part 201 RDWC along the west and north sides of the GCL. Zinc was identified at 11 locations around the GCL with no apparent trend or pattern evident.

Operation and maintenance (O&M) includes maintenance of the cover system by grass mowing, repair of soil erosion areas of the cover system, and control of animal vectors (burrowing). Site maintenance includes regular maintenance of roads, gates, fences, the stormwater storage pond, and pond outlet, as well as repairs of monitoring wells and methane gas flares. Operation includes groundwater and methane sampling.

V. Progress since the Last Five-Year Review

Figure 2 shows the existing site conditions and activities completed during the last five-year review. The September 2001 Five-Year Review Report listed the following future actions and recommendations:

Continue the Annual Site-Wide Groundwater Program.

Annual site-wide groundwater monitoring has been ongoing since 2001.

Continue To Operate the GETS System Until a Long-Term Solution Has Been Determined, and Continue the Quarterly GETS Monitoring.

Quarterly monitoring of the GETS has been ongoing from 2001 through 2005. Based on analytical data that had been collected, the GETS was shut down in the fourth quarter of 2005. These data showed VOCs, SVOCs, pesticides, and PCBs had stabilized in the groundwater. A pilot study was conducted during the first, second, and third quarters of 2004 to determine if zinc detected in groundwater was due to leaching from the GCL, or from the breakdown of the galvanized monitoring well casing. Based on the results of the pilot study, it was identified that elevated zinc concentrations were due to the breakdown of the galvanized monitoring well casing. In the summer of 2005, the MDEQ began a program to abandon the galvanized wells and replace them with Schedule 40 polyvinyl chloride (PVC) monitoring wells.

The final quarterly monitoring for the GETS was completed in the fourth quarter of 2005. No additional quarterly GETS monitoring is scheduled or anticipated. However, the GETS will be sampled during the 2006 fourth quarter to compare results with the 2005 fourth quarter results. If the 2006 results are consistent with those from 2005 then the GETS will be shut down permanently.

Evaluate Remedial Alternatives

Another recommendation of the 2001 five-year review was to evaluate remedial alternatives, including all, or a combination of, the following (followed by the remedial action):

- a. Repair or replacement of the slurry wall, improvements to the landfill cover, and installation of additional methane gas vents.
 - Twenty-two methane monitoring points were installed around the perimeter of the GCL and five additional methane vents with passive solar flares were installed on the GCL cover system. The igniters on the solar flares are turned on every second (via the solar panel) and ignite only when methane levels are above the lower explosive limit (LEL).
 - The slurry wall was not replaced or repaired due to results of the groundwater analytical data. Monitoring wells located inside the landfill and along the perimeter had not identified any leaching of contaminants outside the GCL area.
 - Improvements were made to the landfill cover (filling in low-level areas and adjusting drainage flow) to eliminate standing water.
- b. Enhancement of the GETS to add the capability to treat inorganic compounds, or the addition of a separate system to capture and treat the groundwater inorganic compounds.
 - Based on the analytical results from the quarterly groundwater monitoring of the GETS, enhancement of the GETS was deemed not necessary. Quarterly groundwater monitoring data was collected until the 2005 fourth quarter (afterwards sampling will be performed on an annual basis). The quarterly groundwater monitoring data identified that both influent and effluent samples from the GETS did not exceed applicable MDEQ cleanup criteria for VOCs during the last five years. Additionally, there are no exceedances of inorganics above RDWC in any of the monitoring wells outside of the GCL. Since there is no complete pathway for inorganics to affect receptors, this would be an incomplete pathway and modifications to the GETS for inorganic removal are not necessary.
- c. Operation of the GETS system on an intermittent basis (standby status) should groundwater monitoring warrant the effectiveness of doing so.
 - After evaluation of the groundwater analytical data collected from the last five years, the groundwater was found to be stabilized and the GETS was shut down in the fourth quarter of 2005. The groundwater analytical data VOCs, SVOCs, pesticides, and PCBs had stabilized in the groundwater. A pilot study determined zinc detected in groundwater was due to the breakdown of the galvanized monitoring well casing.

- d. Evaluate the overall landfill status to determine additional necessary repairs and enhancements which would increase the cost-effectiveness of operation and further ensure protection of human health and the environment.
 - The overall landfill status was evaluated and repairs were performed to the landfill cover. Low areas in the cover, which potentially could collect water, were filled to provide positive drainage, access road and gates were installed and brush and large vegetation was removed.

VI. Five-Year Review Process

Administrative Component

The MDEQ has conducted this five-year review of the remedial actions implemented at the GCL site in St. Louis, Gratiot County, Michigan. This review was conducted from March 2006 through June 2006. This report documents the results of the review. MACTEC assisted in the preparation of the review. MACTEC is a consultant retained by the MDEQ to assist in remedial activities at the GCL.

The MDEQ and their contractors have been frequent visitors to the GCL since the last five-year review due to the construction of improvements in the cover system, methane and groundwater sampling events, and abandonment and installation of monitoring wells. The USEPA conducted a site visit for purposes of this five-year review on June 15, 2006.

Community Notification and Involvement

The USEPA placed a notice in the July 12, 2006 edition of *The Morning Sun* (Attachment 1) notifying the public of the preparation of the this five-year review and that the five-year review would look at:

- Site information
- How the cleanup was done
- How well the cleanup is working
- Any future action needed.

The MDEQ has held a number of public meetings over a period of years to present information and discuss site issues with local residents. The latest meeting was held during the fourth quarter of 2004. The MDEQ has held meetings with the Gratiot County BPW regarding the O&M of the GCL site.

Document Review

The MDEQ has established a repository for the site-related information at the city library in St. Louis. As part of this fourth five-year review several documents were reviewed and added to the repository. This included enforcement documents, design documents, operation and maintenance reports, monitoring data, and various other correspondence. A complete list is attached as Table 1.

Data Review

Groundwater

Groundwater sampling occurred on a quarterly basis for analysis of VOCs. Results from the quarterly events indicate that the influent and effluent samples of the GETS were not above applicable Part 201 Generic Cleanup Criteria, RDWC, Groundwater Contact Criteria (GCC), Residential Groundwater Volatilization to Indoor Air Inhalation (GVIAI), Acute Inhalation Screening Levels (AISL), or Groundwater/Surface Water Interface (GSI). Seven monitoring wells (EW-3, EW-5, EW-8, EW-15, G-13d, OBS-5, and OBS-6) in the area of the GETS were also sampled. Analytical results also show that groundwater concentrations at wells (EW-5, EW-12, G-13d and OBS-6) that have historically been identified with 1,2-Dichloroethane and Diethyl ether at or above the Part 201 RDWC have either stabilized or decreased over time.

Sampling events that included 30 wells around the perimeter have been performed on an annual basis since 2002. Samples from these annual events were tested for VOCs, SVOCs, PCB, pesticides, and inorganics.

Historically, VOCs that were identified at concentrations exceeding the RDWC include 1,2-Dichloroethane and Diethyl ether. Inorganics that were identified at concentrations exceeding the RDWC include lead and zinc, and to a lesser degree, cadmium, and chromium.

Cadmium was identified in two monitoring wells (G-19d, and EW-12) with concentrations above the RDWC criteria. Chromium was identified in one monitoring well (OBS-3) with a concentration above the RDWC criteria. No apparent trend or pattern is evident from the data observed.

Lead was identified in nine monitoring wells (G-7d, G-13d, G-14d, G-15, G-19d, G-21, EW-1, OBS-1, and OBS-2) along the north and west side of the site with concentrations above the RDWC criteria.

Zinc was identified in eleven monitoring wells (G-7d, G-13d, G-15, G-19d, G-20, G-21, EW-1, EW-5, EW-17, OBS-1, and OBS-2) with concentrations above the RDWC criteria. The zinc concentrations in these wells have been attributed either all or in part to the breakdown of the galvanized monitoring well casing. These wells are being replaced with PVC monitoring wells by the MDEQ. None of the inorganic concentrations exceeded Part 201 Generic Cleanup Criteria for Direct Contact Criteria, GVIAI, or AISL at any time. Currently the first phase of well replacement has been completed in March 2006. Three more phases are scheduled over the next three years.

The latest groundwater sampling event was performed during June 2006. The results from this event, portrayed in Figure 3, identify zinc above RDWC in G-7d, G-16d, and G-19d. Benzene and Diethyl ether were also above RDWC at G-16d. All other wells had groundwater samples with concentrations of contaminants of concern below applicable criteria and/or below laboratory detection limits for VOCs, SVOCs, pesticides, PCBs, and inorganics.

Groundwater under the landfill cover system is contaminated with PBB and other typical landfill leachate parameters. Groundwater data has not been recently collected from wells within the landfill because of historic groundwater data.

Landfill Gas

Twenty-two permanent methane monitoring points were installed around the perimeter of the landfill. To date methane does not appear to be migrating from the landfill and affecting any receptor.

An assessment of the methane concentrations based on results from the methane monitoring points and previously existing six methane vents indicated that five additional methane vents were required. Five methane vents were installed with four equipped with mobile solar-powered flares. Two sets of methane vents (Vent 8 and Vent 9, and Vent 10 and Vent 11) were connected with lateral pipes to give flexibility to operating the methane vents and flares in various combinations, if needed.

Monitoring of the methane monitoring points and vents is conducted on a quarterly basis.

Landfill Cover

Identified areas of the cover system where ponded water accumulated were regraded to eliminate ponding and reduce infiltration. In addition to the clay, drainage patterns on the landfill cover were adjusted to flow towards the stormwater lagoon in the northwest corner of the GCL. To date, the GCL cover system is in acceptable physical condition.

Site Inspections

The MDEQ and their contractors have been frequent visitors to the GCL since the last *five-year review due to the construction of improvements in the cover system, methane and groundwater sampling events, and abandonment and installation of monitoring wells*. The USEPA conducted a site visit for purposes of this five-year review on June 15, 2006. The MDEQ has established a repository for the site-related information at the city library in St. Louis. The MDEQ has held a number of public meetings over a period of years to present information and discuss site issues with local residents. The latest meeting was held during the fourth quarter of 2004. The MDEQ has held meetings with the Gratiot County BPW regarding the O&M of the GCL site.

Site inspections conducted during the quarterly and annual groundwater sampling events were used to determine:

- a. The condition of the GCL cover and the presence of ponded water or eroded surface areas
- b. *The integrity of the GCL fence and gates*
- c. The condition of the GETS building and system
- d. The condition of the monitoring wells, well covers, methane monitoring points, methane vents, and solar-powered vent flares.

Modifications and Improvements

In 2003, the MDEQ hired contractors to repair ponded areas on the GCL cover, install improvements to the methane removal system, and complete other miscellaneous improvements. Approximately 12.6 acres of the cover system were regraded to remove ponded water areas (Figure 2). The contractor stripped topsoil from the areas, added

additional impermeable soil to the clay cover to eliminate depressions, replaced the topsoil, and graded to provide a uniform slope across the repaired areas.

Three gates were installed as shown on Figure 2. The first gate was located on the southwest corner of the GCL property to restrict access to the area surrounding the GETS remediation shed and monitoring wells. Approximately 740 feet of chain link fencing was also installed along Jackson Road from the southwest corner of the existing GCL fencing to the new gate to prevent access to this area, which had been used for dumping of rubble and debris. A second gate was installed adjacent to the southeast corner on Jackson Road to prevent unauthorized access to the two-track road that runs parallel to the east side of the GCL, and the third gate was installed on the northeast corner of the GCL to prevent access to monitoring wells from a private two-track dirt road from Croswell Road.

The stormwater detention pond had erosion along the embankments and this was repaired by regrading and seeding. The outlet from the pond was raised to prevent sediment from the pond discharging through the outlet sewer, and the outlet sewer was cleaned of accumulated sediments and organic debris. Brush and small trees were removed from the side slopes of the GCL to prevent root penetration into the cover and to permit mowing of the side slopes. Approximately 200 tons of rubble and debris were removed from the area north of the GETS remediation shed including materials that were dumped into wetland areas.

A 24-foot by 32-foot maintenance garage was constructed as shown on Figure 2. The garage is divided into two areas with a 12-foot by 24-foot area for storage of the site's all-terrain vehicle used for sampling, and a 20-foot by 24-foot maintenance area. The maintenance area is used for preparation before and after groundwater sampling events, for the repair of small equipment, and as a storage and meeting room. A limestone parking area was provided at the garage.

Approximately 2,600 feet of 12-foot wide, 4-inch thick, limestone road was installed from Croswell Road to the garage and the east entrance of the GCL. A 200-foot long limestone road was installed on the southeast corner of the GCL to monitoring wells SW-9, GW-13, G-13d, and G-13S. The road was installed in areas of frequent use which were often difficult to access due to poor field conditions.

VII. Technical Assessment

This section will provide a technical assessment of the performance of the remedy to determine if it is protective of human health and the environment, and whether there are changes in site conditions or other factors that could reduce the protectiveness of the remedy.

Question A: Is the remedy functioning as intended by the decision document?

Yes, based on groundwater and methane analytical data, the remedy is operating and functioning as designed. The remedy at the GCL included constructing a slurry wall around the perimeter of the landfill; installing a perimeter fence; capping the landfill with a compacted clay layer to reduce infiltration; constructing a landfill gas venting system; constructing a GETS; and constructing a lagoon to collect surface water runoff. The remedy was installed to contain the entire landfill both beneath and on the surface in order

to curtail water movement into and from the site, and to prevent more extensive groundwater pollution.

A pathway analysis completed in 2001, identified four pathways that may pose a threat to potential receptors. These were:

- RDWC and GSI, based on groundwater contamination detected outside of the slurry wall
- Residential GVIAI Criteria, based on groundwater VOC contamination and nearby residences
- GCC, based on utility workers coming into contact with impacted water
- AISL Criteria, based on VOC and methane emissions from vents and surface seeps.

VOCs identified exceeding the RDWC include 1,2-Dichloroethane and Diethyl Ether. Inorganics identified exceeding the RDWC include lead and zinc, and to a lesser degree, cadmium, and chromium. None of the concentrations exceeded Part 201 Generic Cleanup Criteria for GVIAI, GCC, or to AISL at any time. Based on the results from monitoring wells adjacent to the residential property to the west of the site, no constituents exceeded RDWC or GSI.

Four surface bodies of water are located in the immediate proximity of the GCL. They are: the Pine River (approximately one mile northwest of the GCL); Emma Burnham pond (approximately 1,300 feet south of the southeast corner of the GCL) which is used for nature observation and possibly pond fishing; and two small ponds (1,300 feet east of the GCL, and 600 feet west of the GCL). Monitoring well data from the annual sampling event has identified six locations containing concentrations of chromium over GSI. However, because groundwater is at sufficient depth below the three local ponds, it is unlikely that groundwater would vent to these surface water bodies. The Pine River is of sufficient distance where impacted groundwater venting to the river is also unlikely.

Based on the depth to groundwater, contaminant concentrations, and site geology (clayey surface soils), it is unlikely that VOC compounds would migrate to nearby residences at levels exceeding GVIAI criteria. Previously, evaluations had noted the presence of clayey and organic-rich surface soils near the GCL, which generally adsorb greater amounts of vapor phase VOCs than wet sandy soils. Groundwater sampling of residential wells has not shown VOCs present in any sampling event which eliminates this pathway at this time.

GCC was evaluated as a potential pathway in the event that utility workers along Jackson Road, south of the GCL encountered a perched groundwater that may have come into contact with the waste in the GCL, and migrated into the roadside ditch. There has been no indication based on groundwater sampling, or visual observations, that perched groundwater has migrated into the roadside ditches.

Three distinct methane accumulation areas were identified during previous investigations. These were located in the northeast quadrant of the GCL, the central portion, and the northwest portion of the GCL. Additional passive gas vents have been installed, and solar

operated flares have been installed on the northeast and central portions of the GCL to relieve gas pressure and minimize the potential for AISL criteria exceedance. Recent methane monitoring conducted on March 28, 2006, has indicated that methane is not migrating from the GCL. Methane was not detected at any monitoring points outside of the GCL. In methane vents which did show methane, readings ranged from 54.6 percent (Vent 6) to 71.9 percent (Vent 2) indicating that adequate vents are functioning properly. The solar-powered flares are currently installed on Vent 2, Vent 6, Vent 9 and Vent 10.

O&M at the GCL includes maintenance of the cover system by mowing; removal of brush; filling of animal burrows; restoration of low spots that collect standing water; repair of eroded areas; maintenance of gates, fences, roads, gas vents, and flares; and groundwater and methane monitoring. This also includes the O&M of the GETS system when active. Current O&M procedures as implemented are maintaining the effectiveness of the response activities. There have been no large variances in O&M cost that would be indicative of potential problems or remedy issues.

Cost reduction has been achieved with the discontinued use of the GETS and reduced groundwater monitoring. Groundwater data has indicated that operation of the GETS system was not necessary to achieve groundwater criteria. Quarterly groundwater sampling has been scaled back to an annual groundwater sampling event.

Institutional controls (IC) are necessary to ensure the protectiveness of the remedy. These ICs include preparation and filing with the Registrar of Deeds a Restrictive Covenant and an environmental protection easement. The covenant and easement will help to maintain the landfill cover system, and restrict groundwater use at the GCL. The State is developing a plan to implement the ICs to ensure protectiveness of the remedy, and the plan will be submitted to the USEPA upon completion. The plan will include a schedule for accomplishing the necessary steps to implement the ICs.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial objectives used at the time of the remedy still valid?

Yes, all exposure assumptions, toxicity data, cleanup levels, and remedial objectives used at the time of the remedy are still valid. There have been no land use changes for the GCL or adjoining properties, no new exposure routes, or receptors, and no new contaminant sources. Groundwater and methane monitoring indicate that there are no complete pathways that would have an adverse impact on public health and the environment. There have been no changes in site conditions that would affect the protectiveness of the remedy.

The remedy is progressing as expected. Site access is limited, the landfill cap is maintained, and gaps in the slurry wall do not appear to affect receptors.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No information has come to light that would call into question the protectiveness of the remedy. There have been no identified ecological risks found, and there have been no natural disasters that have impaired the effectiveness of the remedy.

Technical Assessment Summary

The remedy at the GCL included constructing a slurry wall around the perimeter of the landfill, installing a perimeter fence, capping the landfill with a compacted clay layer to reduce infiltration, constructing a landfill gas venting system, constructing a GETS, and constructing a lagoon to collect surface water runoff.

A pathway analysis completed in 2001 identified four pathways that may pose a threat to potential receptors. These were:

- RDWC and GSI, based on groundwater contamination detected outside of the slurry wall;
- Residential GVIAI Criteria, based on groundwater VOC contamination and nearby residences;
- GCC, based on utility workers coming into contact with impacted water; and
- AISL Criteria, based on VOC and methane emissions from vents and surface seeps.

VOCs identified exceeding the RDWC include 1,2-Dichloroethane and Diethyl Ether. Inorganics identified exceeding the RDWC include lead and zinc, and to a lesser degree, cadmium and chromium. None of the concentrations exceeded Part 201 Generic Cleanup Criteria for GVIAI, GCC, or to AISL at any time. Based on the results from monitoring wells adjacent to the residential property to the west of the site, no constituents exceeded RDWC or GSI.

VIII. Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. HELP model indicates that 9.64 million gallons of precipitation percolates through the cover system each year.	N	Y
2. Slurry wall is discontinuous at the southwest portion of the GCL, and to a lesser extent along the northern side.	N	Y
3. Grades on the landfill are less than four percent, and settlement of the cover system continues, which can reduce runoff and increase leachate production.	N	Y
4. The remedy does not provide for unrestricted land use and ICs are required to maintain the cover system, and restrict groundwater use on the GCL.	N	Y

Repairs were made to the GCL cover system to eliminate ponded areas of surface water and provide positive drainage to the stormwater storage pond, or perimeter stormwater ditches. However, additional settlement of the GCL may occur as waste decomposes.

The potential for settlement and infiltration of precipitation remains an issue that could affect future protectiveness of the remedy.

IX. Recommendations and Follow-up Actions

It is recommended that the following actions be taken to maintain the effectiveness of the remedy:

- b. Continue site-wide annual groundwater monitoring and reporting. This action would affect future protectiveness of the remedy, and determine if the slurry wall is functioning sufficiently to protect the public and the environment.
- c. Continue quarterly methane monitoring on on-site and off-site monitoring locations. This will include the future monitoring of methane concentrations in the groundwater. This action would affect future protectiveness of the remedy, and determine if the slurry wall is functioning sufficiently to protect the public and the environment.
- d. Monitor and maintain the cover system. It is necessary to maintain the cover system, mow grass, repair erosion areas, repair settlement areas, maintain methane vent and solar flares, add new vents and flares as required, and other O&M activities. This action would affect future protectiveness of the remedy.
- e. Reactivate the GETS, including any necessary sampling, if groundwater data indicates an unacceptable increase in groundwater concentrations outside the southwest corner of the landfill. This action would affect future protectiveness of the remedy.
- f. Develop a plan to implement the ICs necessary to ensure the protectiveness of the remedy. The State will submit the plan to the USEPA in six months (March 2007). The plan itself will include a schedule for accomplishing the necessary steps to implement the ICs.

X. Protectiveness Statement(s)

The remedy at the GCL is complete and is protective of human health and the environment at this time, and exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to remain protective in the long-term the landfill cap must be maintained and effective ICs must be implemented, maintained, and monitored.

Site remedies are effective and all pathways that may affect potential receptors are incomplete at the time of this five-year review. Site fencing limits access to the site and allows only authorized visitors. The slurry wall constructed around the perimeter of the GCL has gaps on the southwest side and partially on the northern side; but the concentrations in the groundwater still appear to be protective. Groundwater data indicates that groundwater quality outside of the slurry wall has remained stable and there is no migration off the GCL property. A clay cover system has been installed over the waste materials and periodic repairs have been completed. Methane gas vents and solar-powered flares are relieving gas pressure in the landfill and methane monitoring of off-site monitoring probes show that methane gas is not migrating from the landfill to any

appreciable extent. Continued groundwater and methane monitoring is also necessary to ensure that the remedy remains protective of human health and the environment.

XI. Next Review

The next five-year review for the GCL site will be completed by the MDEQ prior to September 30, 2011, the 25th year after the initial remedy action.

TABLES

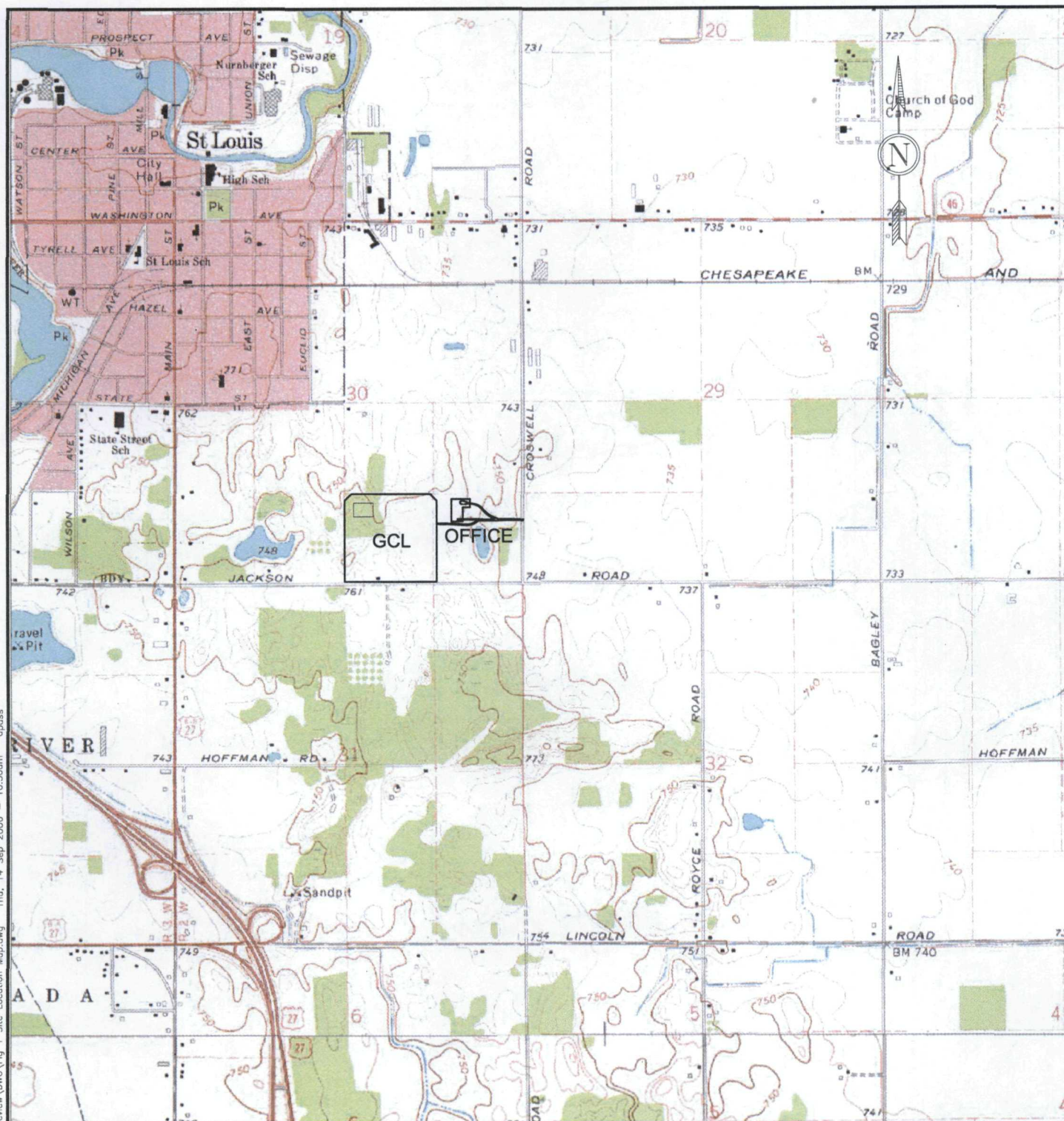
TABLE 1 - SITE CHRONOLOGY, GRATIOT COUNTY LANDFILL, ST. LOUIS MICHIGAN

DATE	DOCUMENT/ACTION	AUTHOR
1971	Landfill Site Suitability (Geologic) Investigation	Michigan Department of Natural Resources (MDNR)
May-77	Phase I Investigation	Keck Consulting Services, Inc.
1978	Phase II Investigation	Keck Consulting Services, Inc.
December-78	Feasibility Study of Control Measures for the Containment of PBB and Other Contaminants	Harza Engineering Company
June-79	Hydrogeologic Investigation and Engineering Alternatives for Control Measures	MDNR
September-80	Bentonite Evaluation	International Minerals & Chemical Corp.
December-80	Phase III Hydro Investigation	Keck Consulting Services, Inc.
August-81	Short-Term Permeability Testing Results	D'Appolonia Consulting Engineers
November-81	Results of Classification and Permeability Testing	D'Appolonia Consulting Engineers
1982	Evaluation of Remedial Action Alternatives	Ecology & Environment, Inc.
May-82	Environmental Impact Assessment	MDNR - Resource Recovery Division
December-82	Consent Decree	MDNR/USEPA
December-82	Site Proposed to the NPL	USEPA
September-83	Site Finalized on the NPL	USEPA
March-84	GCL Construction Plans	MDNR
June-86	Groundwater Purge System Design - Phase I Investigation	E. C. Jordan Company
August-86	Technical Memorandum (Tech Memo) - Water Level and Water Quality Plots and Interpretation	E. C. Jordan Company
April-90	GCL Status Report - Vol I of II	GZA-Donahue
May-91	5 Year Review Document	United States Environmental Protection Agency (USEPA)
January-92	Hydrogeological Investigation	GZA-Donahue
January-95	Performance Evaluation Addendum	Eder Associates
June-95	Final Work Plan	ABB
July-95	Preliminary Closeout Report	USEPA
August-95	Tech Memo #1 - Groundwater Monitoring	ABB
November-95	Tech Memo #1 - Annual Groundwater Monitoring	ABB
November-95	Tech Memo #3 - Gas Vent Repair	ABB
November-95	Tech Memo #2 - Groundwater Monitoring	ABB
December-95	Tech Memo #2 - Annual Groundwater Monitoring	ABB
February-96	Tech Memo #5 - Groundwater Flow	ABB
May-96	Tech Memo #4 - Aquifer Pump Tests	ABB
June-96	Revised Workplan	ABB
July-96	5 Year Review Document	USEPA/MDEQ
July-96	Conceptual Design Groundwater Treatment System	ABB
July-96	Tech Memo #6 - Groundwater Sampling	ABB
October-96	Tech Memo #7 - Zinc in Wells	ABB
January-97	Draft Monitoring Plan	ABB
March-97	Response to Comments - GETS	ABB
March-97	Monitoring Plan	ABB
September-97	Tech Memo #8 - Groundwater Monitoring	HLA
June-05	Tech Memo #9 - Groundwater Monitoring	HLA
July-98	Monitoring Reduction - NPDES	HLA
July-98	GETS start up	
May-99	Final Workplan	HLA
July-99	Tech Memos #10 & #11 - Groundwater Monitoring	HLA
May-00	Tech Memo #12 - Groundwater Monitoring	HLA
August-00	Final (Revised) Workplan	HLA
November-00	Tech Memo #13 - GETS Sampling Event	HLA
April-01	Cap and Slurry Wall Investigation Report	Harding ESE
April-01	Tech Memo #14 - Groundwater Monitoring	Harding ESE

April-01	Tech Memo #15 - GETS Sampling Event	Harding ESE
July-01	Tech Memo #16 - GETS Sampling Event	Harding ESE
September-01	Tech Memo #17 - GETS Sampling Event	Harding ESE
September-01	Third Five-Year Review	USEPA/MDEQ
December-01	Tech Memo #18 - Annual Groundwater Monitoring	Harding ESE
April-02	Tech Memo #19 - GETS Sampling Event	Harding ESE
July-02	Tech Memo #20 - GETS Sampling Event	Harding ESE
October-02	Tech Memo #21 - GETS Sampling Event	Harding ESE
January-03	Tech Memo #22 - GETS Sampling Event	MACTEC Engineering and Consulting of Michigan, Inc.
April-03	Tech Memo #23 - GETS Sampling Event	MACTEC Engineering and Consulting of Michigan, Inc.
June-03	Tech Memo #24 - GETS Quarterly Monitoring Event	MACTEC Engineering and Consulting of Michigan, Inc.
September-03	Tech Memo #25 - GETS Quarterly Monitoring Event	MACTEC Engineering and Consulting of Michigan, Inc.
October-03	Landfill Cap Repair Activities Begin	MACTEC Engineering and Consulting of Michigan, Inc.
December-03	Tech Memo #26 - GETS Quarterly Monitoring Event	MACTEC Engineering and Consulting of Michigan, Inc.
March-04	Tech Memo #27 - Installation and Monitoring of Methane Points, Vents, and Flares	MACTEC Engineering and Consulting of Michigan, Inc.
March-04	Tech Memo #28 - Groundwater Treatment System and Methane Monitoring – First Quarter	MACTEC Engineering and Consulting of Michigan, Inc.
June-04	Tech Memo #29 - Groundwater Extraction Treatment System and Methane Monitoring – Annual Sampling	MACTEC Engineering and Consulting of Michigan, Inc.
August-04	Tech Memo #30 - Comparison of Metals Concentrations in Groundwater – Pilot Study	MACTEC Engineering and Consulting of Michigan, Inc.
August-04	Tech Memo #31 - Groundwater Treatment System and Methane Monitoring – Third Quarter	MACTEC Engineering and Consulting of Michigan, Inc.
October-04	Tech Memo #32 - Groundwater Treatment System and Methane Monitoring – Fourth Quarter	MACTEC Engineering and Consulting of Michigan, Inc.
March-04	Tech Memo #33 - Methane Monitoring - 2004	MACTEC Engineering and Consulting of Michigan, Inc.
March-05	Tech Memo #34 - Groundwater Treatment System and Methane Monitoring – First Quarter	MACTEC Engineering and Consulting of Michigan, Inc.
June-05	Landfill Cap Repair Activities Completed	MACTEC Engineering and Consulting of Michigan, Inc.
June-05	Tech Memo #35 - Groundwater Extraction Treatment System Annual Monitoring Event	MACTEC Engineering and Consulting of Michigan, Inc.
August-05	Tech Memo #36 - Groundwater Extraction Treatment System Annual Monitoring Event	MACTEC Engineering and Consulting of Michigan, Inc.
October-05	Tech Memo #37 - Groundwater Extraction Treatment System Annual Monitoring Event	MACTEC Engineering and Consulting of Michigan, Inc.
November-05	GETS shut down	
September-06	Current Five-Year Review	USEPA/MDEQ

FIGURES

P:\MDCO\MDER-LOE\GPA-CCL\3293038010\5-Year Review\DWG\Fig 1 Site Location Map.dwg Thu, 14 Sep 2006 10:50am dpos



Taken from the Alma, Michigan, 7.5 Series
U.S.G.S. Topographic Quadrangle Map

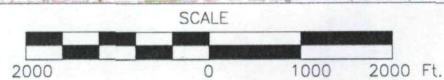


FIGURE 1
FOURTH FIVE YEAR REVIEW
SITE LOCATION MAP

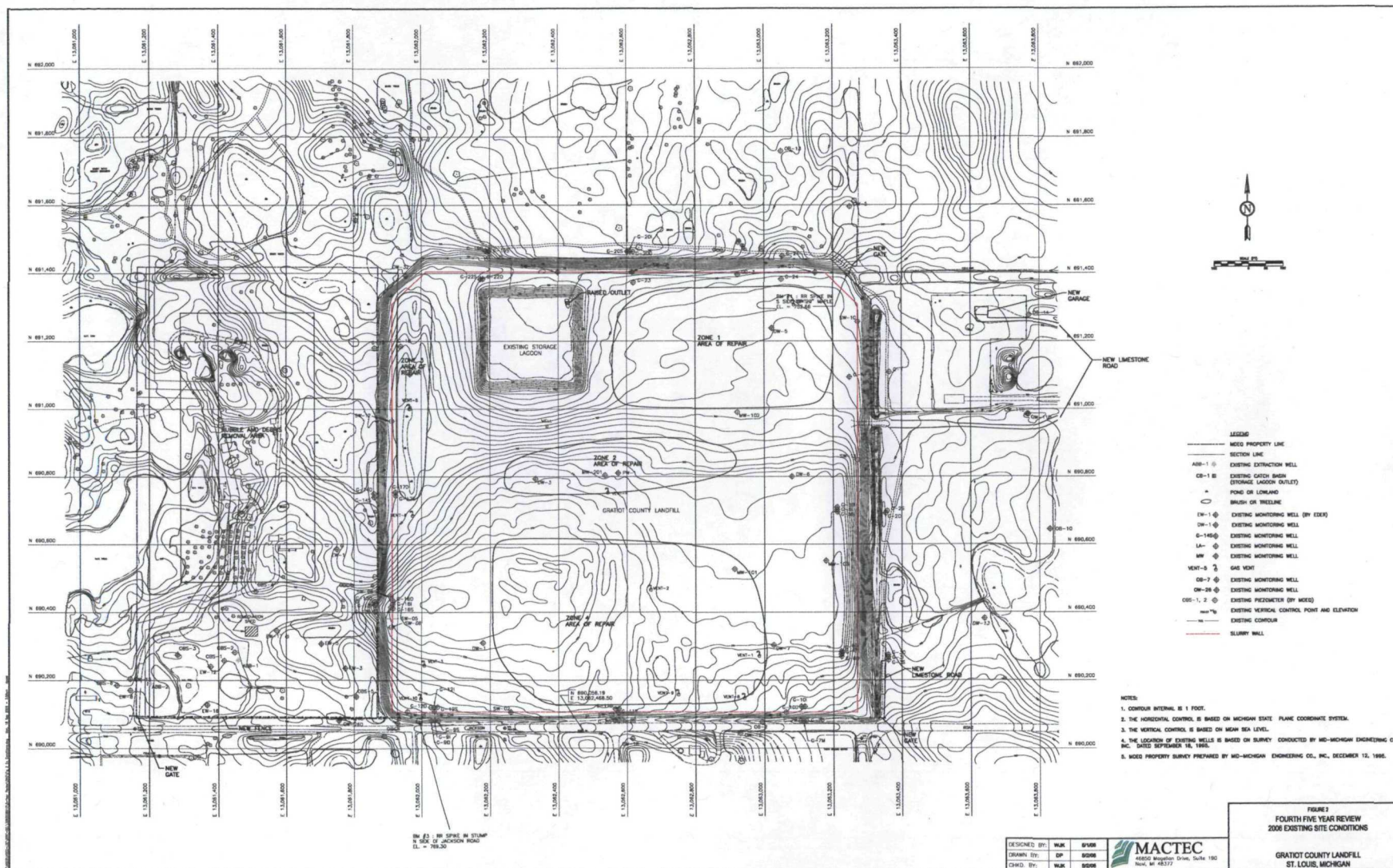
GRATIOT COUNTY LANDFILL
ST. LOUIS, MICHIGAN

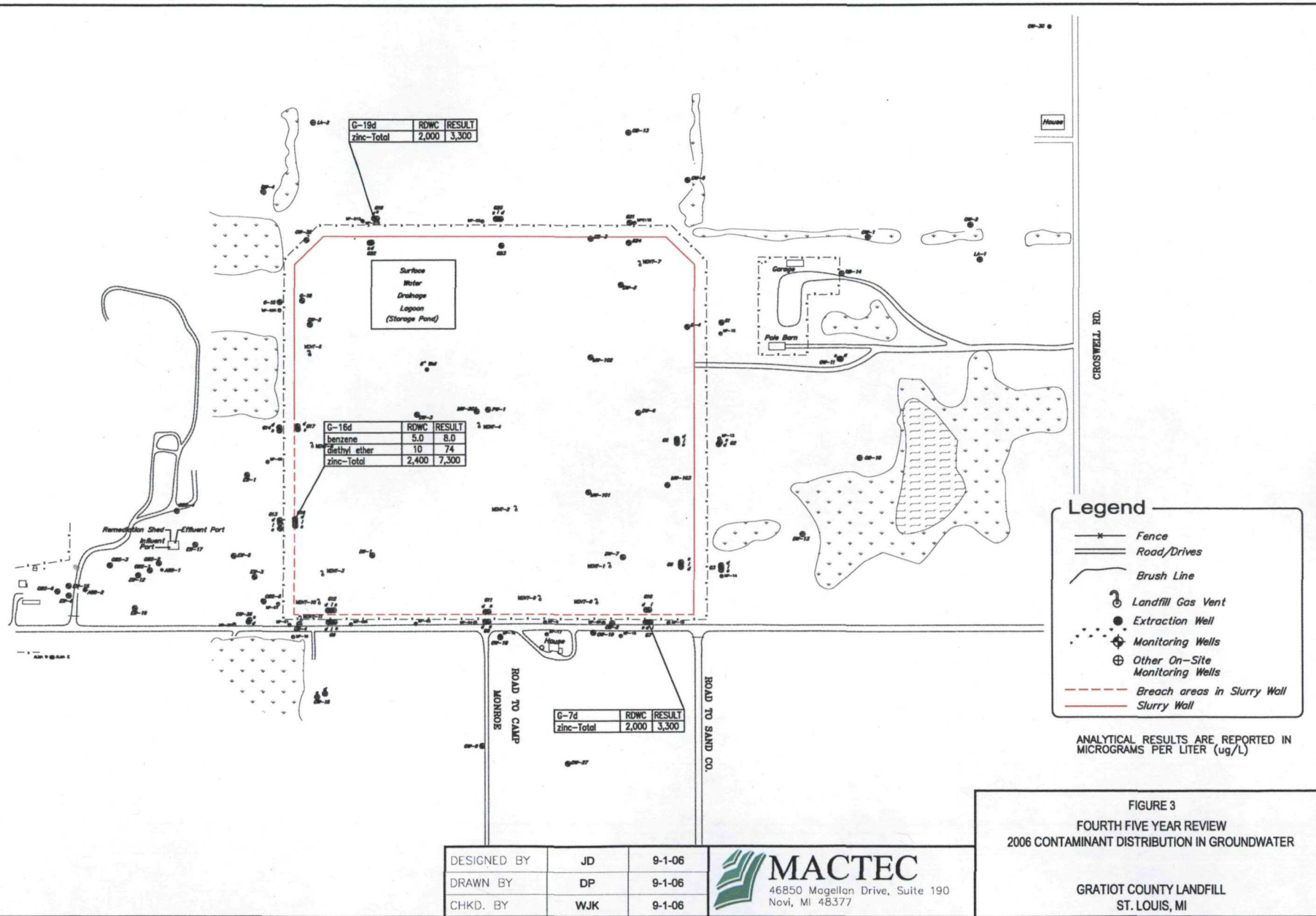
DESIGNED BY:	WJK	6/1/06
DRAWN BY:	DP	6/2/06
CHKD. BY:	WJK	6/2/06



MACTEC

46850 Magellan Drive, Suite 190
Novi, MI 48377





ATTACHMENTS

ATTACHMENT 1

8A • THE MORNING SUN Wednesday, July 12, 2006



EPA Reviews Gratiot County Landfill Superfund Site Gratiot County, Michigan

U.S. Environmental Protection Agency in conjunction with the Michigan Department of Environmental Quality is reviewing the effectiveness of the cleanup at Gratiot County Landfill Superfund site near St. Louis, Mich. Superfund law requires five-year reviews of sites where the cleanup is either done or in progress but hazardous waste remains on-site. These five-year reviews are done to ensure that the cleanup remains effective and protects human health and the environment.

The pump and treat system installed in 1998, effectively lowered contaminant levels in the groundwater, and was shut down in early 2005.

The five-year reviews look at:

- site information
- how the cleanup was done
- how well the cleanup is working
- any future actions needed

This is the fourth five-year review for Gratiot County Landfill and the results will be available by fall 2006.

Site records are available for review at:

St. Louis City Library
312 Michigan Ave.
St. Louis

Questions or concerns regarding the cleanup or the review should be directed to:

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rodriguez.katherine@epa.gov